

Motion Control and Motor Interfacing

e-Yantra Team
Embedded Real-Time Systems Lab
Indian Institute of Technology-Bombay

IIT Bombay
March 9, 2020



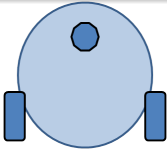
Agenda for Discussion

- 1 Basic Movements of Robot
 - Motions of Robot
 - Understanding L293D IC

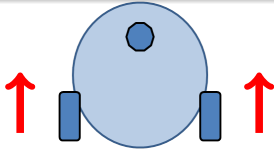
- 2 Motor Interfacing on Firebird V
 - Pin connections
 - Logic Table
 - Algorithm
 - Example function



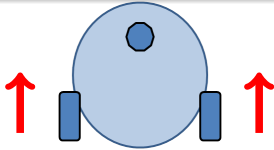
Various Motions



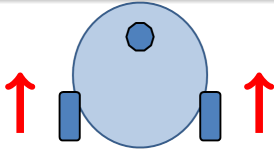
Various Motions



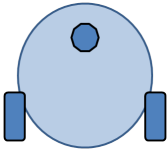
Various Motions



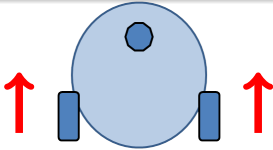
Various Motions



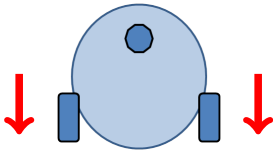
Forward



Various Motions



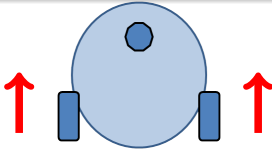
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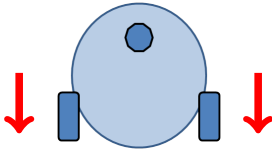
Backward



Various Motions



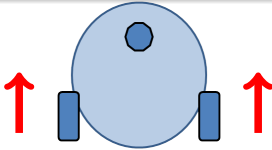
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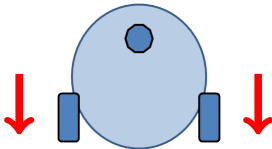
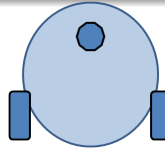
Backward



Various Motions



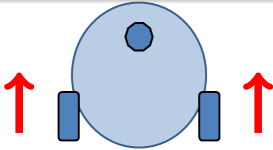
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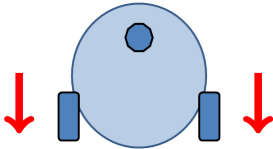
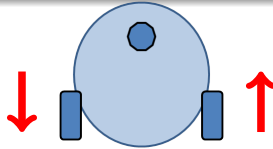
Backward



Various Motions



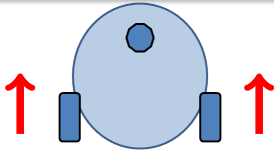
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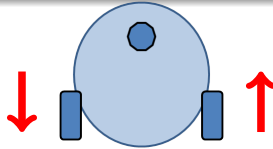
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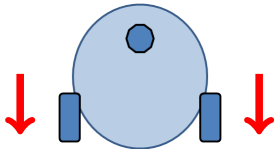
Various Motions



Forward



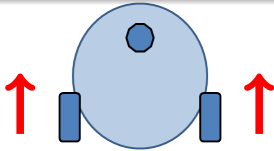
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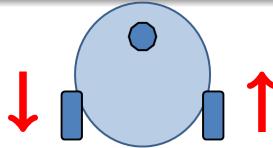
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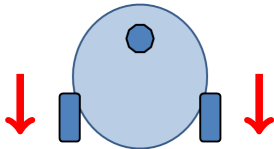
Various Motions



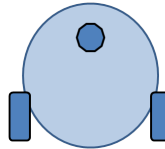
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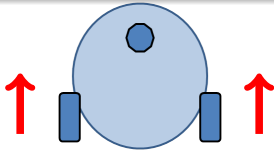
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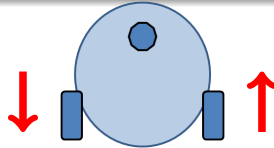
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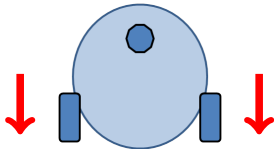
Various Motions



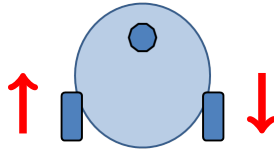
Forward



Left



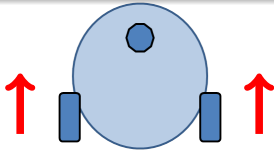
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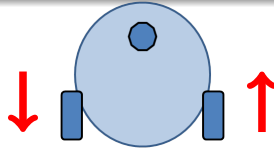
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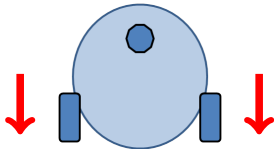
Various Motions



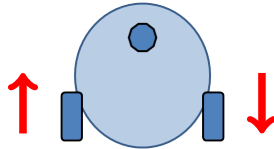
Forward



Left



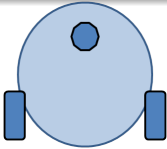
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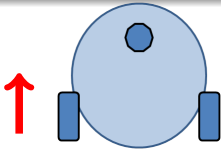
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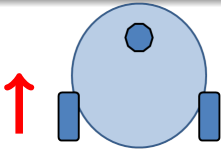
Various Motion (Contd..)



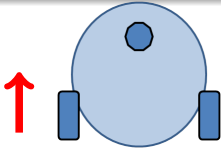
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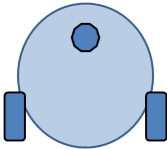
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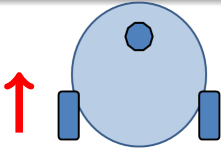
Various Motion (Contd..)



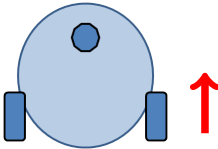
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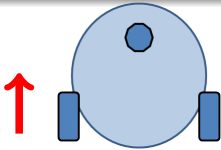
Various Motion (Contd..)



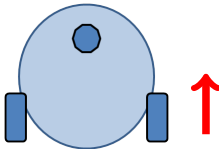
Soft-Right



Various Motion (Contd..)



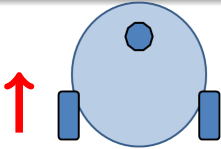
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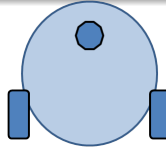
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Various Motion (Contd..)



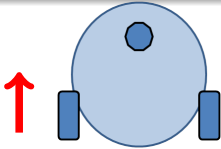
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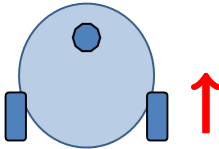
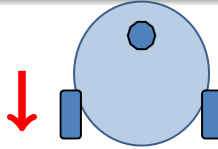
Soft-Left



Various Motion (Contd..)



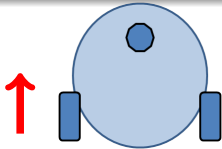
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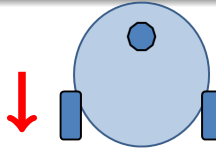
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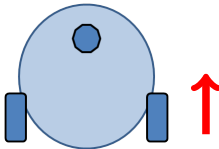
Various Motion (Contd..)



Soft-Right



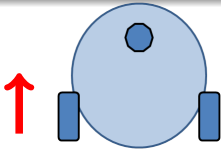
Backward Left



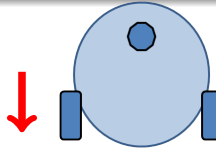
Soft-Left



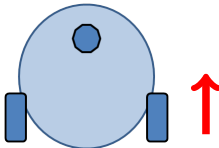
Various Motion (Contd..)



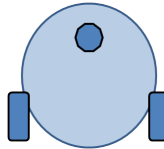
Soft-Right



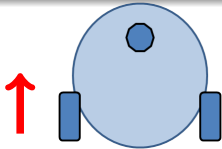
Backward Left



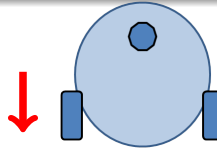
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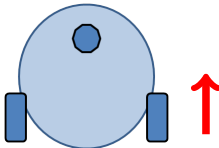
Various Motion (Contd..)



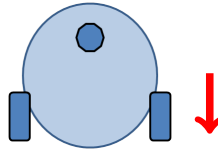
Soft-Right



Backward Left



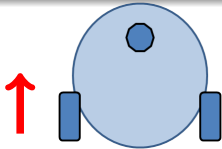
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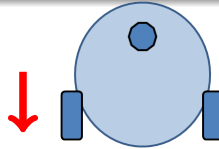
Backward Right



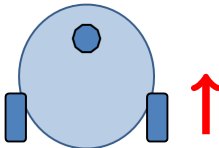
Various Motion (Contd..)



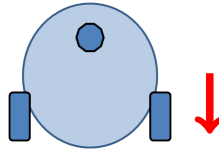
Soft-Right



Backward Left



Soft-Left



Backward Right

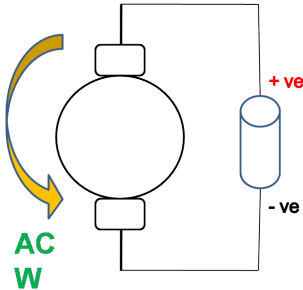


Direction Control of DC Motor



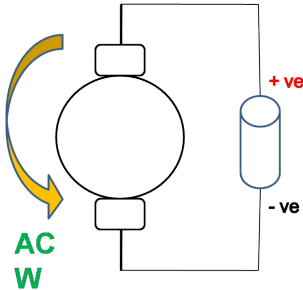
Direction Control of DC Motor

Anti-Clockwise Motion



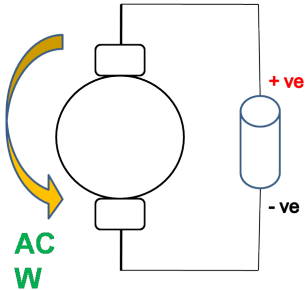
Direction Control of DC Motor

Anti-Clockwise Motion

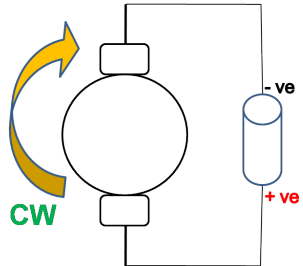


Direction Control of DC Motor

Anti-Clockwise Motion



Clockwise Motion



Need of L293D IC



Need of L293D IC

- ① Maximum current that a port pin can source / sink is 20mA



Need of L293D IC

- 1 Maximum current that a port pin can source / sink is 20mA
- 2 These currents are too low for Motors to run.



Need of L293D IC

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- 2 These currents are too low for Motors to run.
- 3 DC Motor with the output load requires a current of up to 500mA to attain maximum speed.



Need of L293D IC

- ➊ Maximum current that a port pin can source / sink is 20mA
- ➋ These currents are too low for Motors to run.
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- ➍ For this additional current, a Motor driver is required.



Need of L293D IC

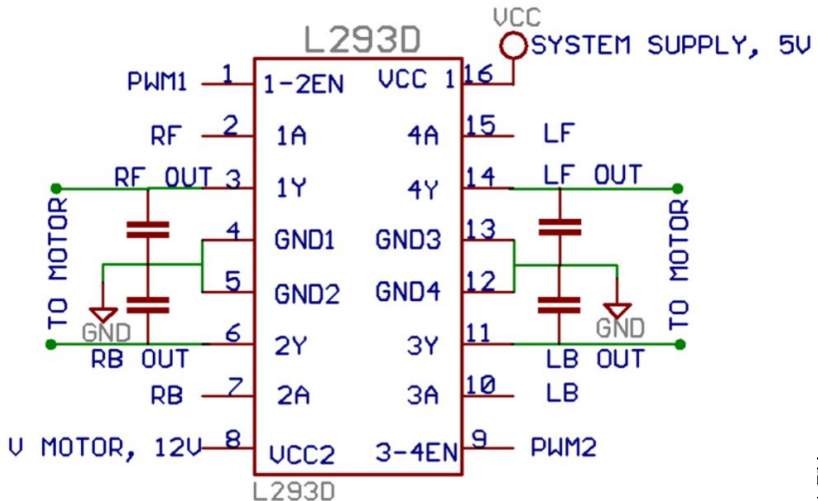
- ➊ Maximum current that a port pin can source / sink is 20mA
- ➋ These currents are too low for Motors to run.
- ➌ DC Motor with the output load requires a current of up to 500mA to attain maximum speed.
- ➍ For this additional current, a Motor driver is required.
- ➎ One such suitable driver is the L293D Motor driver.



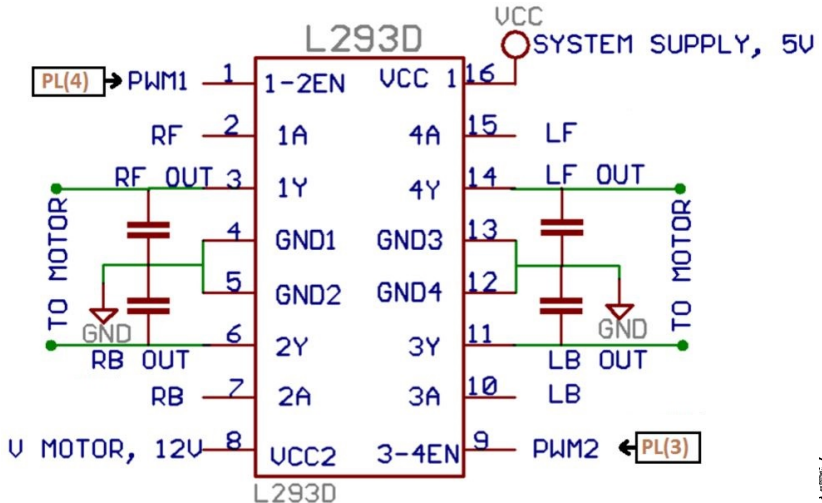
L293D IC



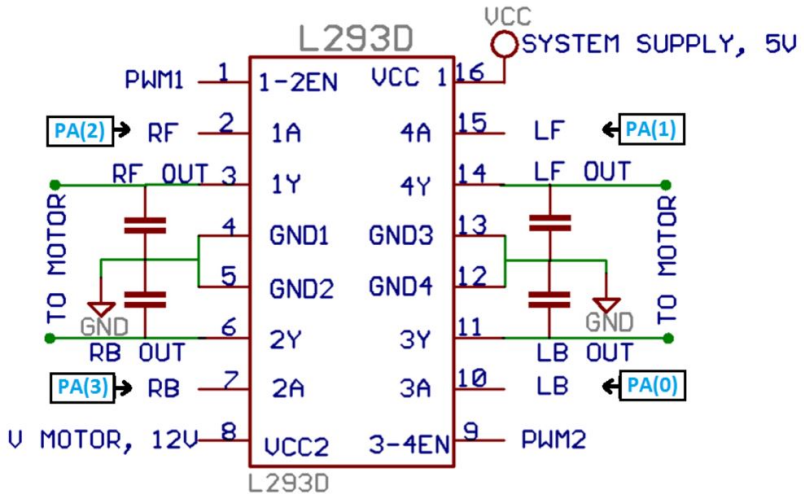
L293D IC



L293D IC



L293D IC



Motor Pin Connection



Motor Pin Connection

- ① Four Pins for Direction control is connected at PORT A



Motor Pin Connection

- ① Four Pins for Direction control is connected at PORT A



Motor Pin Connection

- ① Four Pins for Direction control is connected at PORT A
 - a. PA0 - Left Motor Control
 - b. PA1 - Left Motor Control
 - c. PA2 - Right Motor Control
 - d. PA3 - Right Motor Control



Motor Pin Connection

- ① Four Pins for Direction control is connected at PORT A
 - a. PA0 - Left Motor Control
 - b. PA1 - Left Motor Control
 - c. PA2 - Right Motor Control
 - d. PA3 - Right Motor Control
- ② Two Pins for Enabling Motor Driver IC is connected at PORT L



Motor Pin Connection

- ① Four Pins for Direction control is connected at PORT A
 - a. PA0 - Left Motor Control
 - b. PA1 - Left Motor Control
 - c. PA2 - Right Motor Control
 - d. PA3 - Right Motor Control
- ② Two Pins for Enabling Motor Driver IC is connected at PORT L



Motor Pin Connection

- ❶ Four Pins for Direction control is connected at PORT A
 - a. PA0 - Left Motor Control
 - b. PA1 - Left Motor Control
 - c. PA2 - Right Motor Control
 - d. PA3 - Right Motor Control
- ❷ Two Pins for Enabling Motor Driver IC is connected at PORT L
 - a. PL3 - Left Channel Enable
 - b. PL4 - Right Channel Enable



Logic Table



Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB



Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward				



Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0



Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward				



Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1



Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left				



Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left	0	1	0	1



Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left	0	1	0	1
Right				



Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left	0	1	0	1
Right	1	0	1	0



Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left	0	1	0	1
Right	1	0	1	0
Soft Left				



Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left	0	1	0	1
Right	1	0	1	0
Soft Left	0	1	0	0



Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left	0	1	0	1
Right	1	0	1	0
Soft Left	0	1	0	0
Soft Right				



Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left	0	1	0	1
Right	1	0	1	0
Soft Left	0	1	0	0
Soft Right	0	0	1	0



Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left	0	1	0	1
Right	1	0	1	0
Soft Left	0	1	0	0
Soft Right	0	0	1	0
Stop				



Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left	0	1	0	1
Right	1	0	1	0
Soft Left	0	1	0	0
Soft Right	0	0	1	0
Stop	0	0	0	0



Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB	Hex value
Forward	0	1	1	0	6
Backward	1	0	0	1	9
Left	0	1	0	1	5
Right	1	0	1	0	A
Soft Left	0	1	0	0	4
Soft Right	0	0	1	0	2
Stop	0	0	0	0	0



Algorithm



Algorithm

Problem Statement: Move the robot Forward for 1000ms and Stop.



Algorithm

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① Configure motor pins:



Algorithm

Problem Statement: Move the robot Forward for 1000ms and Stop.

- 1 Configure motor pins:



Algorithm

Problem Statement: Move the robot Forward for 1000ms and Stop.

- ❶ Configure motor pins:
 - Configure direction pins as output. Keep the initial value for motor as logic 0



Algorithm

Problem Statement: Move the robot Forward for 1000ms and Stop.

① Configure motor pins:

- Configure direction pins as output. Keep the initial value for motor as logic 0
- Configure enable pins as output. Enable the channels by setting these pins



Algorithm

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- ❸ Call the delay function with 1000ms delay



Algorithm

Problem Statement: Move the robot Forward for 1000ms and Stop.

- ❶ Configure motor pins:
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- ❷ Move the robot forward by giving appropriate value on direction pins
- ❸ Call the delay function with 1000ms delay
- ❹ Stop the robot by giving appropriate value on direction pins



Example function



Example function

Function to make Firebird-V move Right (Hex value - A)

```
void motors_move_right(void)
{
    motors_port_reg &=
    ~ ((1 << motors_RF_pin) | (1 << motors_LB_pin));
    // Make RF and LB LOW

    motors_port_reg |=
    ((1 << motors_RB_pin) | (1 << motors_LF_pin)) ;
    // Make RB and LF HIGH
}
```



Thank You!

